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AIRPLANE SPEEDS OF THE FUTURE.

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The history of the making of predictions as to the future of aeronautical development is coextensive with the history of flying itself. Indeed it goes much farther back, for we may fairly include among such predictions the vehement asserverations of all those who, scarce two decades ago, knew with absolute certainty that no airplane would ever fly and that it was folly to waste one's time in seeking to emulate the birds.

The making of forecasts has advanced to a stage beyond the point of total denial of a possibility of flight, but there has never been a time when the guesses of an earlier year as to the probable accomplishment within a specified period were not being nullified by the facts.

Prediction as a Guide.

Despite the partial futility of speculating as to what will be done in the face of a virtual certainty that one's speculations will fall wide of the mark, the attempt is nevertheless of some use. The making of estimates of what performance will be two or ten or forty years from now at least gives a mark at which to aim and it affords a little guidance to those whose affairs are likely to be modified by the development of the aeronautical art. Even a poor prediction is better than none.

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Manifestly a clear look into the future can best be obtained if we gain perspective by retiring into the past to gain our point of view. History and prophecy are successive stages of the same process and the present forms only a point on the line of events, not a sharp break between two distinct sequences. The historical perspective was given in last week's article, and the future may be treated as was the past under the three headings of speed, altitude, and duration. Most of the important functions to which the aircraft are turned, especially in the domain of commerce, will be found to depend primarily on one of these elements of performance or on combinations among them. We shall confine ourselves for the present to speed, leaving altitude and duration for subsequent treatment.

Unlimited Speeds Talked Of

It has long been the delight of prophets and of inventors whose sanguineness has outpaced their discretion of speech to talk of speeds increasing without limit, of speeds of 400, 600, and 800 miles an hour and even more. The burden of proof is always on the man who says that a thing is impossible, for much which was supposedly impossible has had a way of being realized in engineering science, but at least it can be definitely stated that such speeds as those just mentioned are not in present prospect and cannot be realized with airplanes approaching the present type, and even if they could it would be impractical to make use of them for commercial purposes. The exposition of the reasons for this statement requires a little

arithmetic. An airplane flying 240 miles per hour, only a little higher than the best speed reached by Lieutenant Maughan at Detroit, has a propeller thrust of about one and a quarter pounds for every horsepower of the engine. That is the only force available to drive the airplane and there is no conceivable way in which it can be increased more than a few per cent. Indeed, if the propeller were 100 per cent efficient, with no power losses at all, the driving force would be only one and six-tenths pounds per horsepower. To secure more than that would be to get more power out than is put in and would effectively be perpetual motion.

At the present time, high-speed airplanes fly very inefficiently at maximum speed as the necessary result of designing for a moderate landing speed. This handicap can only be overcome as suggested in this column several weeks ago, by provision of means of varying the area of the wings or otherwise modifying the lift during flights. We may suppose, however, that such means will be invented and applied and that by refining the design of the airplane to the utmost by withdrawing the wheels into the body and otherwise suppressing every possible ounce of resistance, the total resistance in flight at maximum speed will be reduced to one-eighth of the weight. It is very difficult to conceive of a greater advance than this with an airplane in any way resembling those used at present, and even this is dependent upon engineering advances which will not be made without great difficulty and long research. Supposing it

to be done, however, the maximum weight that the airplane will be able to carry at 240 m.p.h. will be eight times one and one-quarter, or ten pounds a horsepower. In a commercial airplane, at least 75 per cent of this would have to go into the power plant, the airplane structure, the fuel, and the weight of the crew, leaving only 25 per cent, or two and one-half pounds a horsepower, available for paying load. To operate with so low a load ratio as that is obviously uneconomical.

For Commercial Purposes.

If the speed were raised to 300 miles per hour the total load which could be carried on the same assumptions of the maximum reasonable advance in design and invention would be eight pounds a horsepower and the pay load not over one and three-quarters, while for 400 miles the pay load would be cut to certainly not more than one pound a horsepower. These figures are absolute maxima, and they hold good for all altitudes and for all conditions of flight. It may be remarked, however, that one of the most hopeful manners of approaching the conditions set forth, under which the airplane will be able to operate at maximum efficiency and maximum speed simultaneously, is by operation at a very high altitude. A heavily loaded airplane equipped with a supercharger gains speed steadily as it climbs up to a great height, and by flying commercially at altitudes of 20,000 or 30,000 feet, speeds of 200 miles per hour or even a little more may ultimately become practicable for regular trans-

port. To talk of doubling that speed in commercial operation with airplanes or helicopters or airships, however, is only possible for those without knowledge of the facts which govern all air navigation.

The limiting maximum speed of racing airplanes is solely dependent on the point to which the weight carried in flight for every horsepower can be reduced and on the efficiency from an aerodynamic point of view, as represented by the ratio of resistance to weight. If that ratio still be taken as eight, and if the same assumptions regarding the combination of maximum efficiency with maximum speed be continued, the limiting speed would rise to 480 miles per hour, with a total weight of five pounds per horsepower. This is about the lowest power loading that has yet been realized, but of course it may be improved on in years to come. It is nevertheless very difficult to believe in the probability of such speeds as that just mentioned, even with the lightening of structural weights to which we may look forward, as an airplane doing 480 miles an hour at its point of maximum efficiency, even at great altitudes, would be of the most fantastic proportions. Taking as an illustration the engine with which the Pulitzer Trophy was won and which developed 400 horsepower, and supposing it mounted in an airplane weighing 2000 pounds complete ready for flight, the wing surface which would be required for a speed of 480 miles an hour at maximum efficiency and a 20,000-foot altitude would be only nine square feet. In other words, the form

would be that of a winged projectile with a body just large enough to house an engine and pilot and with a single supporting wing only about seven feet wide. Such an airplane could hardly be expected to show the efficiency ratios already specified.

On the whole, it seems perfectly safe to say that we shall not see the attainment of a speed in excess of 325 miles per hour within the next 10 years unless by some unlooked-for invention which modifies the very fundamentals on which the operation of aircraft now rests.